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CONNECTICUT
AGRICULTURAL EXPERIMENT STATION

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SOY BEANS.



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SOY BEANS.

BY E. H. JENKINS.

The Soy bean has been grown for human food in Manchuria, northern India and Japan for ages. It was first raised in this country early in the last century and as a farm crop in the early eighties.

With us it is only grown at present for cattle feed, green manuring and oil and seed production.

Its use as a forage crop is still quite small but it is extending in widely separated regions, for some varieties may be grown for forage wherever corn can be raised.

This bulletin gives some facts about the crop and the uses which farmers may make of it, in the belief that it has a place among paying crops and should at least be tested carefully in Connecticut.

THE SOY BEAN PLANT.

The soy bean, (Soja bean) is an annual, growing best in warm weather and killed by moderate frost. It stands drought rather better than corn or cow peas. It has a branching stem ranging in height, according to the variety, from eighteen to fifty inches or more.

The somewhat hairy leaves, as the picture shows, consist of three leaflets.

The flowers, white or purple, borne in clusters, are abundantly self-fertile. Different varieties, planted together, may occasionally hybridize but not abundantly.

Each of the thick, hairy pods contains two, three, or four seeds.

COMPOSITION OF THE CROP.

The following analyses, made of the Massachusetts station furnish a comparison of soy bean forage and seed with those of other commonly used feeds.

The forage compares in feeding value with clover and alfalfa and the beans have about the same percentage of protein and twice as much fat as linseed meal.

The forage and seed therefore supply a very concentrated feed capable of reducing greatly the need of boughten concentrates. Both are relished by cattle and have proved to be satisfactory for feeding dairy stock, sheep and swine.



COWPEAS AS A COVER CROP.

It is a hot weather, dry weather crop, does its nitrogen-gathering and makes its growth quickly and can be harvested

in time to fit the land for winter grain. Its high protein content, fitness for a variety of soils, moderate fertilizer requirements and other qualities make it worth a trial.

PERCENTAGE COMPOSITION AND DIGESTIBLE NUTRIENTS OF SOY BEAN COMPARED WITH THAT OF OTHER FEEDS.

| | No. of analyses | Composition | | | | | | | Digestible | | | |
|----------------------|-----------------|-------------|-----|---------|-------|-----------------------|------|--|------------|-------|-----------------------|------|
| | | Water | Ash | Protein | Fiber | Nitrogen free extract | Fat | | Protein | Fiber | Nitrogen free extract | Fat |
| Soy beans | 40 | 80 | 2.2 | 3.9 | 5.1 | 8.1 | 0.7 | | 3.0 | 2.2 | 6.3 | 0.3 |
| Alfalfa | 6 | 80 | 1.6 | 2.7 | 6.2 | 9.1 | 0.4 | | 2.0 | 2.7 | 6.6 | 0.2 |
| Red clover | 13 | 80 | 1.8 | 3.1 | 5.7 | 8.8 | 0.6 | | 2.0 | 3.0 | 6.3 | 0.4 |
| Corn fodder | 76 | 80 | 1.0 | 1.6 | 4.6 | 12.4 | 0.4 | | 0.9 | 2.8 | 9.4 | 0.3 |
| <i>Seed or Meal.</i> | | | | | | | | | | | | |
| Soy beans | 8 | 1.4 | 4.8 | 32.8 | 4.4 | 26.9 | 17.1 | | 29.8 | — | 21.8 | 15.9 |
| Cotton seed meal | 404 | 7 | 6.7 | 44.6 | 6.5 | 25.2 | 10.0 | | 37.5 | 2.3 | 19.7 | 9.4 |
| Linseed meal O. P. | 138 | 8.5 | 5.2 | 34.3 | 8.5 | 36.4 | 7.1 | | 30.5 | 4.8 | 28.4 | 6.3 |

YIELD.

When grown for seed, yields reported by the New Jersey station range from 15 to 25 bushels per acre and 100 pounds of cured forage to each bushel of seed. The Ohio station gives yields of 19 to 28½ bushels from different varieties, with an average of about 18 bushels, and 62 to 116 pounds of straw for each bushel of seed.

The Delaware station reports, as average of five years' tests with different varieties, from 14.6 to 35 bushels per acre. Of 57 varieties tested in that state, 30 yielded 25 bushels or more and 10 produced over 30 bushels.

The Massachusetts station reports an average yield of 24.4 bushels of seed and 1,950 pounds of straw. The Medium Green variety at that station yielded 10.3 tons of green fodder as against 16 tons of Longfellow corn fodder. The cost of growing the two crops was about the same and the acre yield of three feed ingredients in pounds was:—

| | Protein | Fat | Fiber |
|---------------------------|---------|-----|-------|
| In green soy bean forage | 1,167 | 234 | 1,418 |
| In Longfellow corn fodder | 871 | 290 | 1,626 |

Other states report 5 to 10 tons of green fodder as a general average, with a feeding value about like alfalfa.

USES IN THIS STATE.

The most obvious use of soy beans is as a *catch crop*. If winter grain, fall or spring-sown clover, or grass seed fails, soy beans, drilled just after corn planting or even late in June, will yield a soiling crop of excellent quality for use in late August and into September and may be removed in time to seed winter grain.

By planting several varieties which differ in their periods of growth, the period in which the crop can be fed green may be prolonged from August 15 to frost.

The best time for cutting is when the pods are well formed but before the lower leaves have begun to turn yellow and fall.

It can also be silaged, not alone but with corn or late-sown millet at the rate of two loads of either to one of soy beans, using a corn binder to harvest them,.

Growing soys in the hill with corn has not been generally successful in other states.

Soy bean hay is about equal to alfalfa if it is successfully cured and the stems are not too coarse. For hay, varieties must be chosen having tender stems, maturing rather early, and the rate of seeding should be heavy.

Soy beans as a green manure in young orchards offers a good chance to test different varieties, and learn methods of handling, etc. They can be drilled the first of June, cultivated for a month and then, when orchard cultivation naturally stops, they will grow rapidly, taking moisture and plant food and checking somewhat the tree growth.

In late September, or earlier, if early sorts are used, they can be plowed or disked and rye sown, or they can be left to be cut down by frost and lie until spring on the ground.

In this way the owner may test rates of seeding and try a number of varieties and find which will mature seed and which will yield the best forage. He will also get his land inoculated, thus probably increasing his yields from year to year, as well as the nitrogen-gathering from the air.

For Seed. While prices of soy beans are as high as at present, growing for seed has been profitable. For this they should be planted rather thinner than for forage, using varieties which will nearly ripen before frost and which do not shatter badly. When the leaves have begun to turn yellow and drop and the pods are browning, light frosts will not injure the seed.

A bean threshing machine is desirable though a grain thresher may be adjusted to do fairly good work.

SOY BEANS FOR HOG PASTURE.

In southern states this bean has been used for hog pasture. Bulletin 154 of the Alabama station reports experience in pasturing lots of ten pigs, each weighing at the beginning about 45 pounds, on an acre of soy beans for from 43 to 62 days, feeding at the same time to each lot either one, two, or three pounds of corn daily per 100 pounds live weight.

The total value (7 cents per pound) of the pork made on each acre, after deducting the cost of the corn feed, was

| | | | | | |
|--------------------|--------|------|----|-------|---------|
| with $\frac{1}{4}$ | ration | corn | as | above | \$28.23 |
| " $\frac{1}{2}$ | " | " | " | " | 25.84 |
| " $\frac{3}{4}$ | " | " | " | " | 39.13 |

These are averages of three years' experience.

VARIETIES.

The experience of Massachusetts may safely be applied to Connecticut conditions of climate.

The Medium Green variety, brought from Japan by Prof. W. P. Brooks, of the Massachusetts station, and grown at the station more or less for 25 years, has only been injured by frost twice during the time. Prof. Brooks says of it, "On good land not extravagantly fertilized it grows about breast high, and can be depended upon, when planted in rows about 2 feet apart, at the rate of a half bushel of seed to the acre, to yield about 12 tons of forage harvested when the pods are mostly filled but before they begin to ripen."

The Medium Yellow, which Prof. Brooks regards as essentially the same as Ito San, is fairly satisfactory but does not yield as much seed or forage as the medium green.

The Early White ripens before frost as surely as corn. It is too small for forage.

The station will greatly enlarge its test of varieties in connection with selection work and hopes to have the most promising varieties growing at its farm next summer.



COVER CROP OF SOY BEANS, ABOUT FORTY INCHES HIGH.

In New Jersey Ito San is one of the best varieties for early maturity of seed. Planted June 1, it was harvested September 10, and had matured seed when planted July 27, but this must be exceptional.

The Wilson stands between the seeding and soiling varieties. It is lighter in stalk than Ito San and somewhat twining in habit.

AS TO PLANTING.

Inoculation. It is harder, in our experience, to thoroughly inoculate land for soy beans than for other legumes. Like alfalfa, a partial inoculation the first year makes it quite effective in the following year. The best material is 500 pounds of soil from a field where the crop has grown well. Failing this, the artificial cultures of the trade may be used, although our experience with them has not been encouraging.

A well-prepared seed bed is as desirable for soy beans as for all other seeded crops.

Rate of Seeding. For seed production, drill the beans in rows 24–36 inches apart (20 inches is suitable for the small early varieties), and drop the beans 2–4 inches apart in the row, covering about an inch deep.

With rows 30 inches apart, 10–12 quarts of seed to an acre are needed.

The cultivation costs about as much as corn cultivation.

For growing forage, seeding may be done with a wheat drill, using $1\frac{1}{2}$ bushels per acre, thus avoiding the expense of cultivation.

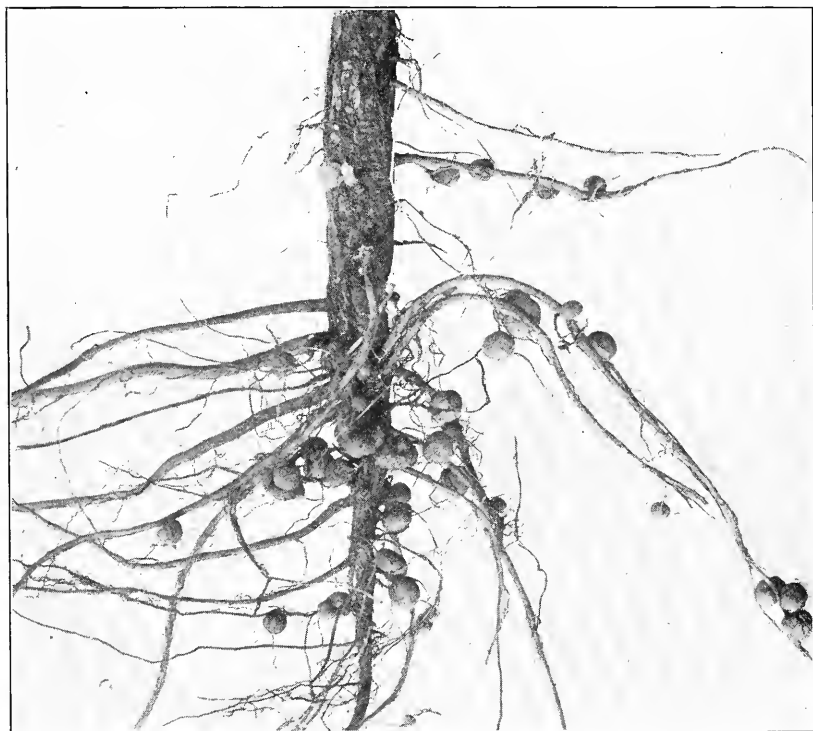
Fertilizers. Land fit for corn is fit for soy beans, only an amount of available nitrogen necessary for corn is not required by soys. 300 pounds of acid phosphate or of basic phosphate and 100 pounds of muriate of potash on lands which are not in good condition will no doubt pay in many cases.

Our Own Experience.

Many years ago we planted soy beans, on very light, sandy soil of the Montowese plain, with a moderate amount of phosphate and potash and without inoculation. The beans grew about a foot high and were a failure. The next year on the same land they grew waist high and were very thrifty. No record of yields was kept. In 1910 and 1911 they were grown on the Centerville farm in plots severally inoculated with various commercial inoculating cultures, none of which proved

very effective, but the second year's crop was larger than the first year's, indicating a natural inoculation of the land.

The variety was an early one yielding 1,254 pounds of well dried seed, about 20.9 bushels per acre and 1,339 pounds of straw, or 64 pounds of straw to the bushel of grain. The analyses are given on p. 12. In 1912 soy beans were grown as a



NODULES CONTAINING NITROGEN-GATHERING BACTERIA
ON ROOTS OF SOY BEAN.

cover crop on the Mt. Carmel orchard (trees set two years). They were planted late, July 20th, and made unsatisfactory growth.

In 1913 the Hollybrook soy bean was drilled in rows 26 inches apart on June 12th, where soys had grown the year

before. The orchard received 1 ton ground limestone, 133 lbs. nitrate of soda, 116 lbs. acid phosphate and 160 lbs. muriate of potash per acre. The beans were cultivated a few times before July 15, when cultivation ceased. During July and August there was very little rain and all crops suffered. On September 27 the soys were dark green, about 40 inches high,



COVER CROP OF SOY BEANS ON LEFT, BUCKWHEAT ON RIGHT.

a few bottom leaves turning yellow. The pods had set, but were still very immature. The roots were abundantly set with nodules. From a measured area the plants were gathered, weighed and analyzed, with the results on p. 12. calculated to the acre. The first killing frost came on October 21. At that time the pods had not browned much but the seed was plump and cured well.

On other plots buckwheat and cow peas were grown under like soil conditions, for comparison of their value as cover crops, and harvested at the same time. The results in pounds per acre are as follows:—

| | Soy Beans | Cow Peas | Buckwheat |
|------------------|-----------|----------|-----------|
| Water | 12,913 | 16,515 | 8,200 |
| Mineral matter | 641 | 560 | 340 |
| Vegetable matter | 3,323 | 2,522 | 2,490 |
| Total yield | 16,877 | 19,597 | 11,030 |
| Nitrogen | 96 | 72 | 53 |
| Phosphoric acid | 17 | 11 | 12 |
| Potash | 68 | 72 | 79 |

It appears that this year the soy beans yielded considerably more vegetable matter and nitrogen than did either the cow peas or buckwheat.

The analyses and yields per acre of the soys grown for seed in 1911 at Centerville and in 1913 at Mt. Carmel for forage, (Hollybrook variety) with acre yields are as follows:—

| | Per cent | Centerville | | Mt. Carmel | |
|-------------------------|----------|-----------------------------|----------|----------------------|------------------------------|
| | | Straw Pounds per acre | Per cent | Soy Bean Per cent | Forage Pounds per acre |
| Water | 5.73 | .. | 5.21 | .. | 76.51 12913 |
| Ash | 6.64 | .. | 5.09 | .. | 3.80 641 |
| Protein | 3.75 | 50 | 40.75 | 511 | 3.55 599 |
| Fiber | 42.65 | 571 | 4.30 | 54 | 6.50 1099 |
| Nitrogen-free extract.. | 40.35 | 540 | 28.09 | 352 | 9.09 1535 |
| Fat (ether extract) ... | 0.88 | 11 | 16.56 | 207 | 0.55 93 |

16,878

Two varieties from L. P. Nemzek, Gibbsboro, N. J., were grown for seed. They were labeled "304" and "Kentucky". Both fully matured their seed in late September. "304" is stated to be Ito San previously grown in Kansas, "Kentucky"

is a variety imported from Manchuria in 1911 and successfully grown in Kentucky in 1912. Both were rather small varieties, planted in rows 20 inches apart. "304" yielded 784.6 lbs., or 13.1 bushels of dry seed per acre, with 1,331 lbs. of straw.

The average height of the stalk (387 measurements) was 22.9 inches and average number of pods per plant 18.

The Kentucky variety was apparently a better yielder, ten days later in maturity, but the stand was too uneven to make a reliable measurement for yield.

The average height of the stalks was 19.2 inches (498 measurements) and average number of pods per plant 39.

The Hollybrook variety referred to above stood about 40 inches high and was much later in maturing than either Ito San or Kentucky. The leaves had not yet turned yellow when killing frost came, early in November. The seed was however plump and apparently uninjured. It was not harvested until November 25th.

The composition of the three varieties of beans grown here in 1913 was as follows, calculated to ten per cent. of moisture:—

| Soy Beans | | | |
|---------------------------|--------------|--------------|--------------|
| "304" | | | |
| | "304" | Kentucky | Hollybrook |
| Water | 10.00 | 10.00 | 10.00 |
| Ash | 4.89 | 5.54 | 5.07 |
| Protein | 34.02 | 35.98 | 32.97 |
| Fiber | 5.67 | 4.26 | 6.35 |
| Nitrogen-free extract ... | 27.69 | 25.56 | 28.32 |
| Fat | 17.73 | 18.66 | 17.29 |
| | <hr/> 100.00 | <hr/> 100.00 | <hr/> 100.00 |

The Uses of The Agricultural Station

And How It May Help The Farmer.

The main purpose of this Station is "to promote agriculture by scientific investigation and experiment." The results of this study and experiment were at first printed in its bulletins and reports. But as the station work has increased this could not be done because of limits imposed by law on the size of our reports. Much of the research work, therefore, which is not of immediate practical use to farmers has been printed in various technical journals. Our reports and bulletins summarize and discuss such results of finished work as are of present use to the farmers.

Thus they give information on fertilizers, cattle foods, human food and drugs, on insects and plant diseases which injure crops, and the use of sprays and other means of killing these pests, on the management of woodland, on the practice of plant breeding, etc. They are for careful reading and study.

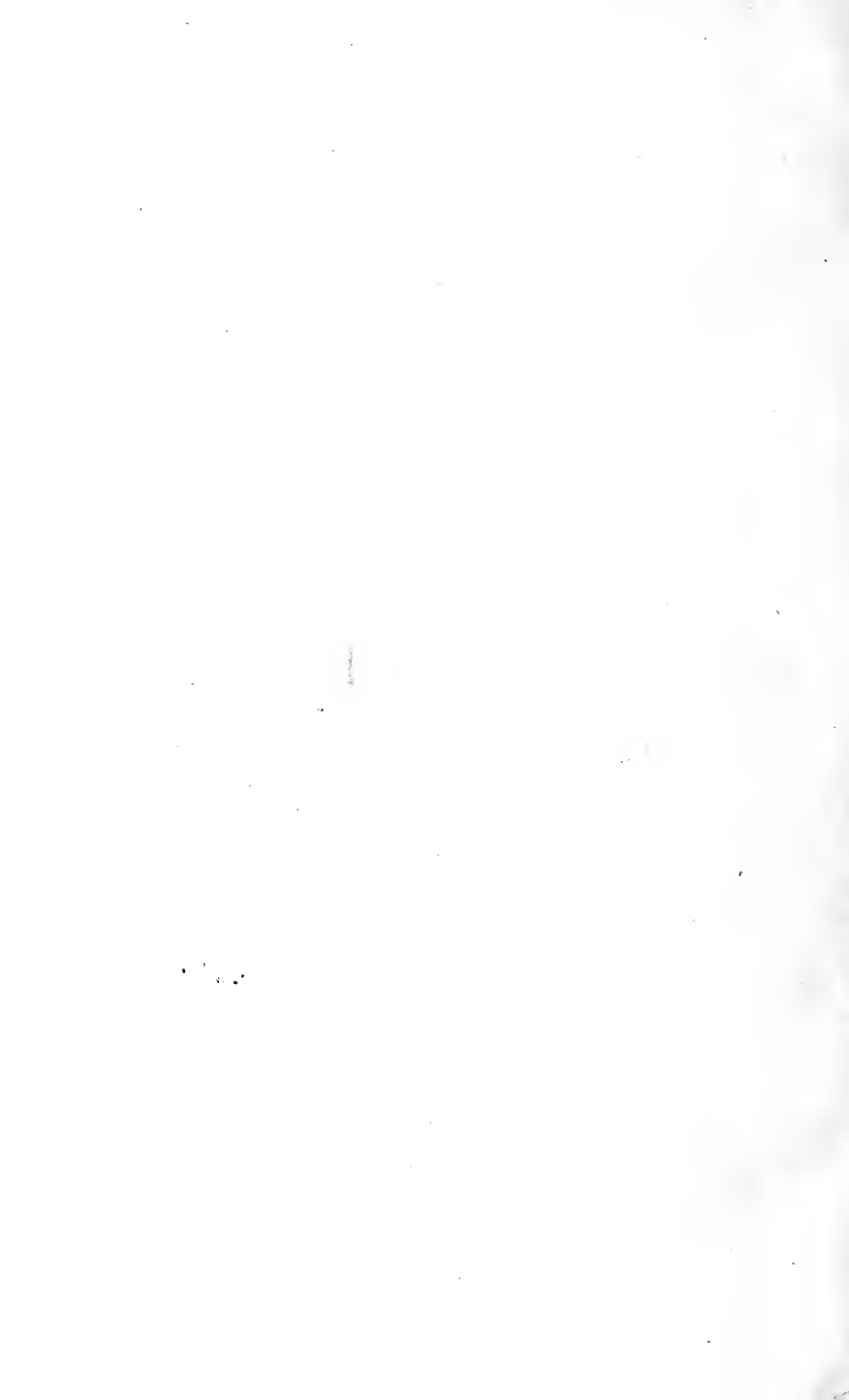
But there is another valuable kind of work which this station does, which is not so well understood or appreciated, because it has been entirely done by correspondence with individuals and therefore never shows in print. To this we wish to call special attention. There are of course many subjects of great importance to farmers which our bulletins and reports do not touch.

This must be so for no Station without vastly larger funds than our own can do creditable work in all those departments of science, which can serve the farmer. On many of these subjects members of the staff can give helpful information and advice, or if not will refer the inquirer to the persons or institutions which can give it. The number of letters and manuscript reports daily sent by the station, averaging forty for every working day in the year, gives some idea of the extent of this service to individual farmers at the present time. If copies of these letters were accessible to farmers it is safe to say they would be found less formal, but more practical

and immediately helpful and covering a very much larger field of knowledge than our printed bulletins and reports.

Every farmer in the state has the privilege and the right to apply to the Station for any information he needs and the Station will give every such request its best attention. It will also issue from time to time bulletins which will not deal exclusively with its own work, but will combine with it other information which it may have at command and which its correspondence shows is of general interest and value.

The aim of county advisers, agricultural experts, and the whole extension movement is to bring the work of the Agricultural College and Stations to the individual farmer and such work properly planned and carried out will be of great value. The point of this paragraph is, on the other hand, to urge farmers to come themselves directly to the station, *to bring the farmer to the Station*, for it is distinctively his institution and for his use and he is always welcome.





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